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Contract Strategy - Fixed Price Payment Strategy

[Strat Main](#)

Under a fixed-price contract, the contractor agrees to deliver the product or service required at a price not in excess of the agreed-to maximum. Fixed-price contracts should be used when the contract risk is relatively low, or defined within acceptable limits, and the contractor and the Government can reasonably agree on a maximum price.

According to the [Federal Acquisition Regulation \(FAR\)](#) (link), Section 16, contract types in this category include:

- Firm fixed-price (FFP)
- Fixed-price economic price adjustment (FPEPA)
- Fixed-price award-fee (FPAF)
- Fixed-price incentive firm (FPIF)
- Fixed-price incentive with successive targets (FPIS)
- Fixed-price contract with prospective price redetermination (FPRP)
- Fixed-ceiling-price contracts with retroactive price redetermination (FPRR)
- Firm fixed-price level of effort term contract (FFPLOE)

	Comparison of Major Contract Types				
	Firm Fixed-Price (FFP)	Fixed-Price Economic Price Adjustment (FPEPA)	Fixed-Price Incentive Firm (FPIF)	Fixed-Price Award-fee (FPAF)	Fixed-Price Prospective Redetermination (FPRP)
Principal Risk to be Mitigated	None. Thus, the contractor assumes all cost risk.	Unstable market prices for labor or material over the life of the contract.	Moderately uncertain contract labor or material requirements.	Risk that the user will not be fully satisfied because of judgmental acceptance criteria.	Costs of performance after the first year because they cannot be estimated with confidence.
Use When	<ul style="list-style-type: none"> -The requirement is well-defined. -Contractors are experienced in meeting it. -Market conditions are stable. -Financial risks are otherwise insignificant. 	The market prices at risk are severable and significant. The risk stems from industry-wide contingencies beyond the contractor's control. The dollars at risk outweigh the administrative burdens of an FPEPA.	A ceiling price can be established that covers the most probable risks inherent in the nature of the work. The proposed profit sharing formula would motivate the contractor to control costs to and meet other objectives.	Judgmental standards can be fairly applied by an Award-fee panel. The potential fee is large enough to both: <ul style="list-style-type: none"> -Provide a meaningful incentive. -Justify related administrative burdens. 	The Government needs a firm commitment from the contractor to deliver the supplies or services during subsequent years. The dollars at risk outweigh the administrative burdens of an FPRP.
Elements	A firm fixed-price for each line item or one or more groupings of line items.	A fixed-price, ceiling on upward adjustment, and a formula for adjusting the price up or down based on: <ul style="list-style-type: none"> -Established prices. -Actual labor or 	<ul style="list-style-type: none"> -A ceiling price -Target cost -Target profit -Delivery, quality, and/or other performance targets (optional) 	<ul style="list-style-type: none"> -A firm fixed-price. -Standards for evaluating performance. -Procedures for calculating a fee based on performance against the standards 	<ul style="list-style-type: none"> -Fixed-price for the first period. -Proposed subsequent periods (at least 12 months apart). -Timetable for pricing the next period(s).

		material costs. -Labor or material indices.	-Profit sharing formula		
Contractor is Obligated to:	Provide an acceptable deliverable at the time, place and price specified in the contract.	Provide an acceptable deliverable at the time and place specified in the contract at the adjusted price.	Provide an acceptable deliverable at the time and place specified in the contract at or below the ceiling price.	Perform at the time, place, and the price fixed in the contract.	Provide acceptable deliverables at the time and place specified in the contract at the price established for each period.
Contractor Incentive (other than maximizing goodwill)¹	Generally realizes an additional dollar of profit for every dollar that costs are reduced.	Generally realizes an additional dollar of profit for every dollar that costs are reduced.	Realizes a higher profit by completing the work below the ceiling price and/or by meeting objective performance targets.	Generally realizes an additional dollar of profit for every dollar that costs are reduced; earns an additional fee for satisfying the performance standards.	For the period of performance, realizes an additional dollar of profit for every dollar that costs are reduced.
Typical Application	Commercial supplies and services.	Long-term contracts for commercial supplies during a period of high inflation	Production of a major system based on a prototype	Performance-based service contracts.	Long-term production of spare parts for a major system.
Principal Limitations in FAR Parts 16, 32, 35, and 52	Generally NOT appropriate for R&D.	Must be justified.	Must be justified. Must be negotiated. Contractor must have an adequate accounting system. Cost data must support targets.	Must be negotiated.	MUST be negotiated. Contractor must have an adequate accounting system that supports the pricing periods. Prompt redeterminations.
Variants	Firm Fixed-price Level of Effort.		Successive Targets		Retroactive Redetermination

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Contract Strategy - Cost Reimbursable Payment Strategy**Strat Main**

Under a cost-reimbursement contract, the contractor agrees to provide its best effort to complete the required contract effort. Cost-reimbursement contracts provide for payment of allowable incurred costs, to the extent prescribed in the contract. These contracts include an estimate of total cost for the purpose of obligating funds and establishing a ceiling that the contractor cannot exceed (except at its own risk) without the approval of the contracting officer.

According to the [Federal Acquisition Regulation \(FAR\)](#) (link), Section 16, the contract types in this category include:

- Cost (CR)
- Cost-sharing (CS)
- Cost-plus-fixed-fee (CPFF)
- Cost-plus-award-fee (CPAF)
- Cost-plus-incentive-fee (CPIF)

	Comparison of Major Contract Types				
	Cost-Plus Incentive-Fee (CPIF)	Cost-Plus Award-Fee (CPAF)	Cost-Plus Fixed-Fee (CPFF)	Cost or Cost-Sharing (C or CS)	Time & Materials (T&M)
Principal Risk to be Mitigated	Highly uncertain and speculative labor hours, labor mix, and/or material requirements (and other things) necessary to perform the contract. The Government assumes the risks inherent in the contract —benefiting if the actual cost is lower than the expected cost; or —losing if the work cannot be completed within the expected cost of performance.				
Use When	An objective relationship can be established between the fee and such measures of performance as actual costs, delivery dates, performance benchmarks, and the like.	Objective incentive targets are not feasible for critical aspects of performance. Judgmental standards can be fairly applied. Potential fee would provide a meaningful incentive.	Relating fee to performance (e.g., to actual costs) would be unworkable or of marginal utility.	-The contractor expects substantial compensating benefits for absorbing part of the costs and/or foregoing fee. or -The vendor is a non-profit entity.	No other type of contract is suitable (e.g., because costs are too low to justify an audit of the contractor's indirect expenses).
Elements	-Target cost -Performance targets (optional) -A minimum, maximum, and target fee -A formula for adjusting fee based on actual costs and/or performance	-Target cost -Standards for evaluating performance -A base and maximum fee -Procedures for adjusting fee, based on performance against the standards	-Target cost -Fixed fee	-Target cost -If CS, an agreement on the Government's share of the cost -No fee	-A ceiling price -A per-hour labor rate that also covers overhead and profit -Provisions for reimbursing direct material costs
Contractor is Obligated to:	Make a good faith effort to meet the Government's needs within the estimated cost in the Schedule.				Make a good faith effort to meet the Government's needs within the

					ceiling price.
Contractor Incentive <i>(other than maximizing goodwill)</i> ¹	Realizes a higher fee by completing the work at a lower cost and/or by meeting other objective performance targets.	Realizes a higher fee by meeting judgmental performance standards.	Realizes a higher rate of return (i.e., fee divided by total cost) as total cost decreases.	If CS, shares in the cost of providing a deliverable of mutual benefit.	
Typical Application	Research and development of the prototype for a major system.	Large scale research study.	Research study.	Joint research with educational institutions.	Emergency repairs to heating plants and aircraft engines.
Principal Limitations in FAR Parts 16, 32, 35, and 52	The contractor must have an adequate accounting system. The Government must exercise surveillance during performance to ensure use of efficient methods and cost controls. Must be negotiated. Must be justified. Statutory and regulatory limits on the fees that may be negotiated. Must include the applicable Limitation of Cost clause at FAR 52.232-20 through 23.				Labor rates must be negotiated. MUST be justified. The Government MUST exercise appropriate surveillance to ensure efficient performance.
Variants			Completion or Term		Labor Hour (LH)

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Contract Strategy - Time and Materials Payment Strategy

[Strat Main](#)

Labor-Hour and Time-and-Materials

Two types of compensation arrangements that do not completely fit the mold of either fixed-price or cost-reimbursement contracts are labor-hour and time-and-materials. Labor-hour and time-and-materials contracts both include fixed labor rates but only estimates of the hours required to complete the contract. Because these contracts (1) do not require the contractor to complete the required contract effort within an agreed-to maximum price and (2) reimburse the contractor for actual hours worked, they are generally considered cost-reimbursement contracts.

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Contract Strategy - Liquidated Damages Clause


Strat Main

Liquidated damages are often included in a contract to add protection for the State. In the event the contractor fails to abide by or meet specific milestones or contract terms, the State may assess liquidated damages as recompense for the contractor's failure. The criteria or event (and any evaluation criteria) must be clearly identified in the contract along with the specific dollar amount that will be assessed. The damage amount must be commensurate with the risk and damage done to the State when the criteria or event is not met.

Liquidated damages can be assessed by having the contractor make payment to the State, but more often the project simply withholds the damage amount from the contractor's next invoice(s).

References:

- [DGS Model Contract, IT Purchase Special Provisions](#) (DGS link)



THE GUIDEBOOK OF SOFTWARE ACQUISITION QUESTIONS

A CHECKLIST HELPING LARGE-SCALE,
SOFTWARE-INTENSIVE PROGRAMS TO
USE SOFTWARE BEST PRACTICES



JULY 1999
VERSION 1.0

THE AIRLIE

Software council

This guidebook is one of a series of guidebooks published by the Software Program Managers Network (SPMN). Our purpose is to identify best management and technical practices for software development and maintenance from the commercial software sector, and to convey these practices to busy program managers and practitioners. Our goal is to improve the bottom-line drivers of software development and maintenance—cost, productivity, schedule, quality, predictability, and user satisfaction.

The Airlie Software Council was convened in 1994 as a focus group of software industry gurus supporting the SPMN and its challenge of improving software across the many large-scale, software-intensive systems within the Army, Navy, Marine Corps, and Air Force. Council members have identified principal best practices that are essential to managing large-scale software development and maintenance projects. The Council, which meets quarterly in Airlie, Virginia, is comprised of some 20 of the nation's leading software experts. These little guidebooks are written, reviewed, generally approved and, if needed, updated by Council members. Your suggestions regarding this guidebook, or others that you think should exist, would be much appreciated.

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CHAPTER 1

Introduction

CHAPTER 1

Introduction

This guidebook, developed by the Airlie Contracting Panel for the Software Program Managers Network¹ (SPMN), addresses commonly asked questions and concerns expressed by the government (specifically, federal program managers) and contractors on large-scale, software-intensive programs.

In October, 1996, the SPMN formed the Panel in order to identify some practical solutions to the major problems, conflicts, and issues that government program managers and contractors face. SPMN invited top contracting and software professionals from the U.S. Army, Navy, Air Force, Marines, Office of the Secretary of Defense (OSD), and industry, to serve as Panel members. The Panel (an offshoot of the Airlie Software Council of software experts named after its meeting place, the Airlie Conference Center in Virginia) split its time between large general meetings and smaller group meetings that generated an energetic mix of ideas and proposals. (See the Appendix, “Airlie Contracting Panel Background and Highlights,” for an in-depth discussion of the Panel’s proceedings.)

On the final day of the meeting, the Panel produced a draft document designed to help the government encourage contractors to develop software in accordance with software industry best practices, such as those found in The Program Manager’s Guide to Software Acquisition Best Practices.² Best practices are those software industry management and technical best practices consistently shown by metrics or measures in real-world software development and maintenance programs to improve consistently bottom-line program

parameters (including end user satisfaction, development cost, development productivity, maintenance cost, maintenance productivity, software quality, time-to-market, and cost and schedule predictability). The Panel’s draft document also sought to address the amazing consistency of problems in large-scale projects and to recommend solutions to those problems. The Panel believed that applying these solutions would facilitate defining both government and contractor roles, thereby ensuring that they share the same vision and understanding, and are headed in a parallel direction.

The Software Program Managers Network has taken the Panel’s draft document and worked diligently with the Panel and other industry and government experts to incorporate comments and concerns in preparing this guidebook. The questions in this guidebook relate to the development of a large-scale, software-intensive program. These questions do not encourage any specific methods. Instead, each question gives the government a tool to inquire of contractors, “If you devote materials or effort in the area covered by this question, please describe what you do.” These questions are meant to:

- Provide the government maximum insight into the capability of the contractor in certain critical areas for software development.
- Cause contractors to make explicit commitments as to exactly how they will develop the software called for in the government’s program.
- Spark the effective use of best practices.

CHAPTER 1

Introduction

COMMENTS AND FURTHER INFORMATION

In addressing these goals, the Panel would welcome any input or additions from the Army, Navy, Air Force, Marines, Office of the Secretary of Defense, other government organizations, program managers, private industry, and any other reader on this guidebook (Version 1.0). The SPMN plans to release Version 2.0 sometime in the Spring of 1999.

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CHAPTER 2

Risk and Requirements Management

CHAPTER 2

Risk and Requirements Management

A. Risk Management

- Risk management helps a software developer identify and deal with potential problems as early as possible. This is a fundamental management practice. Because of their complexity, all software development projects have potential risks that can actualize into real problems. Describe your approach to risk management, including risk identification, risk characterization, risk mitigation and transfer, risk tracking, risk control, risk officer responsibilities, and risk contingency budgeting. Describe the extent to which this is a continuous process.
- Identify the top 12 risk items and the probability that they will actualize into real problems; include the severity impact for each actualized risk. For each risk item identified, describe the event or task that will determine whether the risk actualizes, and state when this event or task is scheduled.
- Describe what the customer and his/her supporting activities can do to control risk.
- Discuss the extent to which individuals on the technical staff and subcontractors were involved in identifying the risk items that have been identified up to this time.
- Describe how you both explicitly and implicitly distribute the negative impact of risks becoming problems between your organization and the customer.
- From those risks that you have identified, describe the one which, if it actualizes, will occur latest in the life cycle.
- Describe the technical risk which, if it actualizes, will have the most serious impact of all the technical risks that have been identified.
- From those risks that you have identified, what percentage depend on external factors which are not under your control, and what percentage are likely to actualize into problems?
- Discuss those external dependencies not under your control which can have a serious impact on your ability to deliver capabilities within your cost and schedule. For each of these external dependencies, identify the responsible organization or party, and discuss at least one possible way to work around the possibility that the external dependency may be late or fail to meet your needs.
- Describe what visibility or assessment ability of risk status you will give both to your team members and to the customer. Describe how frequently this visibility will be updated.
- Describe any mechanisms you will put in place to encourage your team members (including subcontractors) to report their concerns about potential risks to the program manager.

B. Requirements Management

- Uncontrolled growth in requirements is a fundamental cause of costly rework, cost growth, and schedule slippage. Describe what you, as the contractor, will do to control requirements growth and volatility. Also describe what the customer and his/her supporting activities can do to control requirements growth.
- Identify the point in the development schedule when system requirements for safety, security, and reliability must be complete and stable. Discuss why you need these requirements complete and stable at this time.

CHAPTER 2

Risk and Requirements Management

- What is your approach to ensure that requirements are complete, consistent, and correct? Identify any tools you intend to use in this approach.
- Discuss the bottom-up and top-down components of your requirements definition process; when each component will occur in your development timeline; how and when the two components will be integrated; and when you will have the functional and allocated baselines under configuration management change control.

C. Requirements Traceability

- Metrics show that requirements defects in general are the most costly to fix. A fundamental factor of this cost is the ability to identify all the information that a requirements change has affected (both forwards and backwards), including the system and software design, the source code, the documentation, and the test cases. Describe how you, as a contractor, will address this issue.
- What is the smallest component of source code for which all code components will have system requirements traced?
- Will system requirements be traced into all individual test cases?
- Will architecture design and detailed design requirements be traced to source code components? If so, what is the smallest component of source code for which all code components will have these requirements traced?
- If you will be using automated tools for system development, describe how you will keep the data managed by individual tools both traceable to and consistent with the requirements in your requirements traceability method.

D. Interface Management

- Describe your approach to managing and tracking interfaces, including user interfaces, external interfaces, and internal interfaces.
- At what point in the development schedule will all user interfaces have been designed?
- Discuss the role that the design of the user interface will have in requirements analysis.
- Discuss the role that the design of the user interface will have in the conceptual design of databases.
- What standards will you impose for application programming interfaces?
- Discuss the involvement that future system users will have in the design of the user interface.
- Describe the contents, if any, of the interface requirements and interface design specifications that you plan to generate or that you require from the customer for external electronic interfaces.
- Describe the contents, if any, of the interface requirements and interface design specifications that you plan to generate for internal electronic interfaces between individual Computer Software Configuration Items (CSCIs) and Hardware Configuration Items (HWCI), and between components of a CSCI.

CHAPTER 3

Planning and Tracking

CHAPTER 3

Planning and Tracking

A. Planning and Tracking

- Discuss how the accuracy of the methods with which you track project status depends on the quality of the planning, and identify the items in this planning for which the accuracy of tracking is the most sensitive.

B. Work Breakdown Structure (WBS)

- What percentage of your total cost estimate is allocated to tasks in your WBS that are at level 3 or lower, where level 0 has the total project as the only task?
- Describe how you will summarize direct costs from cost accounts in the WBS.
- Describe how you will summarize direct costs from cost accounts into your functional organizational elements.

C. Task Activity Network

- Does your task activity network include all areas in which your effort is dependent on factors not under your control? If it does not, describe the external dependencies that are not included in your activity network and how you will track their status.
- Describe the relationship, if any, between your activity network and your risk management program.
- Describe at what future point, if any, your activity network will not include detailed tasks for this contract's entire remaining work.
- What percentage of the total effort is included in your activity network?
- Which leaf task (i.e., a task with no child tasks) in your activity network has the highest budgeted cost for all leaf tasks of the total cost? What percentage of the total project cost is that leaf task?
- What percentage of your total cost estimate is for labor that is directly involved in the development of software, from software requirements analysis through software integration test?
- Does your activity network include all information (other than actual task cost and completion dates) needed for project cost and schedule reporting to the customer? If not, describe the additional information that will be needed for your reporting.
- Have labor numbers been budgeted by labor categories for each task in the activity network? If so, what are the three largest scheduled increases in the number of persons in any labor category over any three-month period?
- How many persons not currently employed by your organization or by one of your subcontractors are scheduled to be added to the project staff in the next eight months in senior design positions for: the system; the computer network; the architecture for a CSCI; or the conceptual design of a database?
- Describe how the work of your subcontractors is integrated into your activity network.
- Did you compute schedule compression for your schedule? If so, what is your algorithm for computing schedule compression, and what is the value you computed for schedule compression?

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Planning and Tracking

D. Critical Path Analysis

- Did you compute the critical path of your activity network? If so, what percentage of tasks in your activity network are on the critical path? What percentage of those tasks not on the critical path have a slack period of five working days or less?
- Relate the critical path to your risk management. Specifically, identify all risk items where the task(s) determining the risk's actualization is on the critical path.

E. Detailed Work Packages

- What percentage of the labor hours under this contract do you anticipate will be charged to level-of-effort activities?
- Of those tasks that are not level-of-effort, what will be the longest duration and the highest-cost leaf task that you will allow as an active task?
- Identify and describe the task parameters to which you will allocate values in all of the leaf tasks in the project activity network. Examples of task parameters that most project management tools support are resources and calendar duration. To what level in your possible hierarchical activity network will you provide the customer visibility into actual performance on tasks versus values allocated to task parameters?

F. Task-Completion Criteria

- Describe your task-exit criteria guidelines for other than level-of-effort tasks.

- Describe how you will ensure that individual task-exit criteria are satisfied throughout the project.
- Describe the relationship you will implement between your task-exit criteria and the cost and schedule reporting that you will provide to the customer.
- Provide an example of a task description that includes task-exit criteria which are representative of the program for non-level-of-effort tasks that have no child tasks.

G. Build Plans

- Identify and describe the life cycle model that you will use, and provide your rationale for selecting and tailoring this model. This rationale should include a discussion of the potential problems that this model is intended to attack.
- If you are proposing an incremental-release life cycle model, specify what increment will complete the following:
 1. The design of the software architecture
 2. The system requirements for safety
 3. The system requirements for security
 4. The system requirements for reliability.
- What percentage of the total lines of source code delivered into operation in the first two deliverable increments do you expect will be in the final release under this contract? Discuss your rationale.
- Discuss the number of releases beyond the release under development for which

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Planning and Tracking

a build plan delivered to the customer will define the capabilities of the release, and discuss the level of detail of these release specifications.

- For how many releases beyond the releases currently under development will you provide a detailed activity network and cost estimate to the customer?

H. Earned Value Progress vs. Plan

- Early discovery of potential cost and schedule problems is fundamental to avoiding cost growth and schedule slippage. Describe your approach to discovering early indications of cost and schedule problems. Discuss at what level of your Work Breakdown Structure you will report to the customer the status of individual tasks, as well as the visibility into the subcontractor's task status. This report should include a description of the indicators, the methods for identifying these indicators, and the frequency of updating these indicators.
- Describe the quantitative measurement of the earned value status, or other cost/schedule status metric, of the software development component of the system development that will be provided with the cost and schedule reporting on this project. Include the extent to which software earned value status will be visible separately from the earned value status of hardware/software subsystems.
- Describe how you will compute and report throughout the duration of the program the current estimate of cost-to-complete and schedule-to-complete, along with any metrics that you will use

to evaluate the validity of these estimates. This response should explicitly discuss whether unresolved risk items are considered in the estimates of cost- and schedule-to-complete. If so, describe how they are considered.

- Describe how you will summarize in the Work Breakdown Structure direct costs from cost accounts as the basis of determining the actual direct costs of individual tasks.
- Describe how you will summarize direct costs from cost accounts in your functional organizations.

I. Project Software Management Metrics

- Identify and define all the management metrics that you will collect and report to the customer on a regular basis and provide your rationale. Your response should include the threshold value for each of these metrics which, if exceeded, indicates a potential problem.
- What metric, if any, will you use to measure your productivity in developing the software for this program?
- What software development productivity metric did you use to estimate the cost of developing this program's software?

J. Software Engineering Metrics

- Identify and describe which software engineering and quality metrics you will collect and report to the customer on a regular basis, and provide your rationale. This response should include the threshold value for each of these metrics which,

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Planning and Tracking

if exceeded, indicates a potential problem.

- What are the major drivers for the cost of fixing defects and modifying and adding capability to operational software like the software to be developed in this program? What is the basis for this answer? Discuss the practices that you will implement during development that target these maintenance cost drivers. Include how each practice attacks the cost of maintenance. Identify any metrics thresholds for the software that you deliver which you will use to ensure that the delivered software can be maintained at a cost lower than the industry average.

K. Deployment Planning Process

- Explain your approach for transitioning software from development to operation. This should include any efforts for the training of operational users, field installation, and configuration control of operational installations. If a currently operational system is to be replaced, how will the new software be made operational without disrupting operations?

L. Postdeployment Support

- Describe your concept of postdeployment software support, including any effort in the areas of: hot-line technical support; collecting and tracking problem reports and engineering change proposals from the field; and analysis of problems reported by operational users.
- The cost of software maintenance increases rapidly as the understandability

of the software decreases. Describe the major measures to improve software understandability that you will make during development, and the acceptable thresholds for understandability. Describe your approach to achieving these understandability objectives.

- The cost of software postdeployment support increases rapidly with the density of defects in the delivered software. What is your delivered-defect-density goal? Describe your approach to achieving this goal. Provide a cost-benefit analysis for this approach.

M. Development Methodology

- Identify and describe the methods that you will use for each of the following: business reengineering; system and software requirements analysis; system, computer network, and software architecture design; database conceptual, logical and physical design; and detailed design of application software. Discuss why you have selected each of these methods. Identify your key software engineer for each of these methods, and describe his/her experience in the method.
- Describe your technical approach for ensuring that the appropriate information flows correctly between interfacing methods.

N. Reuse Opportunities and Problems

- What percentage of the total software size is new code, modified reused code, and unmodified reused code? Identify the source of this reused code and discuss

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the extent that it has been verified and tested. Describe any additional reuse code selection and testing that you will conduct after the contract is awarded.

- Discuss your approach to interfacing reuse code with the local and network operating systems and network middleware to be used for the system.
- Discuss how you will integrate the reuse code into the type of architecture you have chosen for this development and how this integration will preserve those features of this type of architecture that you feel are most important.
- What role, if any, will a common operating environment have in the software to be developed?
- Do you plan to reuse functionality but not source code from some existing software? If so, identify the software and describe how you will extract the reuse functionality from this software.
- Do you plan any reuse of architecture? If so, identify the architecture to be reused and discuss how you will tailor this architecture to the specific requirements of this program.
- If wrapper techniques are used to convert existing software modules into components compatible with the component-based architecture framework, give technical descriptions of these techniques.
- Describe the techniques you will implement to ensure that any component plugged into the component-based architecture framework will only require knowledge of the detailed specification of its Automated Program Interface

(API) in order to implement the capabilities evoked via the API.

O. Software Sizing

- Estimate the size of the software for this contract. How was this estimate developed, and what confidence do you have in this estimate?

P. Cost Estimation

- Did you estimate cost using one or more cost models? If so, which one(s)? What were your input values for the cost estimation parameters of each? Did you estimate cost by analogy with a previous project? If so, describe that project and its similarities and differences with this contract. Did you perform a bottom-up engineering estimate of cost and, if so, how was it done? If you performed more than one cost estimate, how different were these estimates and how were these differences reconciled?
- What percentage of the total labor for this effort is planned for each of the following:
 1. Technical effort for requirements analysis
 2. Technical effort for system architecture design
 3. Technical effort for software CSCI architecture design
 4. Detailed design of software
 5. Software source code generation and unit test
 6. Integration and integration test
 7. Formal inspections

CHAPTER 3

Planning and Tracking

8. Management for cost and schedule control
9. Configuration management
10. Risk management
11. Independent quality assurance
12. Document generation and publication
13. Direct participation in Integrated Product Teams
14. Preparing for and participating in customer reviews
15. Training the development team
16. Installation at field sites including training users
17. Preparing prototypes and other tangible products that will not be delivered to the customer either separately or as part of a contract deliverable.

Q. Project View of Status

- What information will you make available to all persons on the software project team, and what are the methods for conveying this information? Conversely, what information on project status will you solicit from your team (including subcontractors and their team members), and what methods will you use to obtain it?

R. Access to Developer's Database (On-Time, Real-Time)

- What data in the contractor's developmental baseline will be freely available to persons from the customer's program office?

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A. Quality

- Do you have goals for the maximum density of defects in the software that you will deliver? If so, what are these goals?
- Describe how you will ensure that you will meet your goal for delivered defect density.
- Other than defect density, what contract deliverable characteristics do you consider quality attributes? What is the threshold value between acceptable and unacceptable quality for each of these attributes?

B. Defect Identification

- The cost of finding and fixing a defect increases rapidly with the amount of time that passes between making and finding the defect. Describe your approach to finding defects. Your answer should include both your methodologies and the points during contract when these methods will be used.
- If you plan to use any metrics to assess the effectiveness of finding defects during development, describe these metrics and how they measure effectiveness in finding defects.
- Describe the method(s) you will use for finding defects in each of the following areas. Include the specific types of defects that will be targeted and how the method(s) finds each of these defect types. Areas to be addressed include:
 1. Requirements
 2. System architecture
 3. Architecture of computer networks

4. CSCI architectures
 5. Database conceptual design
 6. Detailed design of software components
 7. Database physical design
 8. Source code.
- To what extent will you allow persons from the customer's program office to participate in structured peer reviews?

C. Defect Tracking

- Describe your process for tracking defects, including: what data is tracked; the visibility of this data to your staff and to the customer; and at what point in the program this defect tracking will begin.

D. Test Methods

- Describe your approach to unit testing, including test coverage goals and test documentation.
- Describe your approach for integration and test, and the frequency and types of tests conducted.
- Discuss what you will do during development to lower the cost of regression testing during maintenance.

E. Complexity Control and Metrics

- Metrics consistently indicate that software development productivity and defect density degrade rapidly with software size. Complexity grows rapidly with size. Discuss the management and technical methods you will use on this

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project to manage complexity, including the criteria you will use for the products of each of these methods to ensure effective complexity management.

- Metrics consistently show that the principal cost drivers on a software project change dramatically as the size of the project increases. Discuss what you believe are the principal cost drivers for the software that you plan to develop, and what technique(s) you will employ to attack each cost driver. For each technique, discuss the basis for your belief that this technique will effectively attack the cost driver.
- Describe your approach to measuring the complexity of the software that you deliver, including any associated criteria and actions that may be taken to reduce this complexity. To what extent, and on which projects, has your organization utilized this approach or these actions in other software development efforts?

F. Tool Selection and Effective Deployment

- For each subquestion below, identify any software tools used in that area, including the tool name, vendor, and version number. Where appropriate, discuss how the functionality of these tools will be used on this project:
 1. To enforce each technical and management method or process
 2. To design the user interface to the system. Discuss the capabilities of these tools, including: the graphical user interface standard supported, including the widget set that can be

implemented; automatic code generation; support for insertion of procedural code call backs; insertion of database queries; insertion of middleware interface stubs; and availability of the run-time libraries needed for execution on the target platforms of this program

3. To design and test the design of customer/server networks
 4. For execution test
 5. For reverse engineering
 6. To collect management or software quality metrics automatically.
- If software tools from different vendors are to be used, identify all interfaces where information generated by a tool from one vendor is included in the information input to a tool of a different vendor. For each of these interfaces, describe whether the information input from another tool will be input manually or automatically. If automatically, is the interface Commercial-Off-the-Shelf (COTS) software, or is it to be developed as part of this project?
 - Will data output by a vendor's tool implementing a structured requirements analysis or design method be input to a tool from a different vendor that implements a different structured requirements analysis or design method? If so, describe how the components and component interfaces will be mapped between the two methods.
 - If you will use software tools from more than one vendor, discuss how you will ensure that the data output by all of

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these tools will be made and kept consistent throughout development.

- What data generated through the use of software tools will be delivered to the customer?
- Identify all the automated tools which have some functionality related to configuration management. Discuss how the configuration management capabilities of all of these tools will be integrated.
- If the tool set used on this project is to include a database repository, describe the following:
 1. How the data in this repository will be configuration-controlled
 2. How individual CASE tools will output data into, and input data from, this repository
 3. How the data stored with individual CASE tools will be kept consistent with the data in this repository
 4. The extent to which this repository supports queries to find errors in its data.
- For each software tool that generates source code in any language, state whether a run-time library is needed to execute this code. If so, identify the specific version(s) of these run-time libraries that will allow this code to execute on the target (customer's) computers for the software developed under this contract.
- Discuss how information in paper documents delivered under this contract will be made consistent with information stored in the databases of the automated tools used in this project.
- If software developed under this contract will be deployed on a customer/server network, identify all the middleware customer and server code stubs that will be required. How will these code stubs be generated? How will this code stub software be integrated with application source code automatically generated by a particular software tool?
- Will a software tool be used that automatically generates source code from user interface, database or procedural code design, and will additional code then be added manually to this automatically generated code? If so, discuss how a change to the user interface, database or procedural code design can be made after code has been manually added to the automatically generated code.
- Do you plan to use a software tool that translates source code from one programming language to another? If so, identify the tool, identify the input and output programming languages, and discuss the benefits from this code translation.
- Discuss the extent, if any, that software tools will enforce your software development processes.

G. Software Reliability, Safety, and Security

- Respond to the following questions by providing a separate answer for each of these three issues: a) software reliability; b) software safety; and c) software security.
 1. Are the system and software requirements for a) reliability, b) safety, and c) security adequate to begin the design of CSCI architectures? If

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not, at what point in the system development must requirements be finalized to avoid a risk of substantial rework to meet those requirements? What additional input of a) reliability, b) safety, and c) security requirements is needed from the customer?

2. Will system engineering techniques be used to allocate system a) reliability, b) safety, and c) security requirements between software and hardware? If so, how will this be done?
3. Discuss your approach to meeting software a) reliability, b) safety, and c) security requirements in the design of the architecture of individual CSCIs.
4. Discuss how and when you will verify that a CSCI architecture will support the a) reliability, b) safety, and c) security requirements allocated to the CSCI.
5. Discuss planned methods used to validate how the delivered system meets a) reliability, b) safety, and c) security requirements.

H. Software Quality Assurance Program and Certification Process

- Describe the responsibility and the products of your Software Quality Assurance (SQA) program relative to ensuring that processes, standards, and conventions are followed.
- Describe the responsibility, methods, and products of your SQA organization rela-

tive to technical verification by persons on the SQA staff.

- Describe the responsibility and the products of your SQA organization relative to integration or system test by persons on the SQA staff.
- To what level in the project and in the corporate organization is SQA free to report without prior permission?
- What results from SQA activities will be made available to the customer, and when?
- If your project plans to perform structured peer reviews, will the SQA staff participate in these reviews?

I. Project Stability

- Identify the areas in which volatility will have the greatest negative impact on project success, and describe your method(s) in each of these areas to keep volatility below some threshold. What are these thresholds?

J. Configuration Management

- Describe your configuration management approach and process, including the following:
 1. The baselines you will control and the contents of each of these baselines
 2. Change control of customer-controlled baselines
 3. Change control of developmental baselines
 4. Configuration status accounting
 5. Formal configuration.

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- Identify every category of information that will be under configuration management, and discuss the format (e.g., flat file, relational database) in which the information of each category will be stored.
- Describe how configuration management is integrated between your organization and subcontractors.
- Discuss the configuration management that you will impose on operating systems, middleware, COTS and nondevelopmental item (NDI) application software, and development environment tools.

CHAPTER 5

Award fees and other
Incentives

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Award fees and other Incentives

A. Chapter Summary

- Award fees and other incentives can motivate contractors to use software development best practices. By encouraging the use of best practices, innovative incentives can improve bottom line program parameters (including end user satisfaction, development cost, development productivity, maintenance cost, maintenance productivity, software quality, time-to-market, and cost and schedule predictability).
- This chapter first defines how award fees and other incentives function, then raises issues regarding award fees and other incentives for the government to consider before it forms contractor questions, and, finally, suggests possible contractor questions related to incentives.
- Selecting the type of contract to be implemented is as fundamental a decision as there is in the acquisition process. In the software acquisition process, the complex nature of the effort and the end-product may require an extra level of sophistication or experience on the part of the government as well as the contractor.
- The government team and the contractor team have in-depth acquisition decisions to make of both a business and engineering nature.
- In more recent years, the “award fee” contract has been found effective when used for software projects. The most successful software projects have been government and contractor teams which work closely together and think “outside of the box.”
- Government thinking on incentives must go beyond fulfilling the many specific Federal Acquisition Regulations (FAR). The government and contractor teams individually and together must be inventive and innovative.
- After the individual government and contractor teams look at the same contract from different sides, it is imperative that they look at that contract from all sides together.
- This chapter refers frequently to the Federal Acquisition Regulations governing contracts and contract incentives. Readers interested in studying the FAR, an essential step for adequate contract preparation, can download it at the following Web site:
www.arinet.gov/far/97-01/html.
- More experienced government acquisition specialists, who already know very well how award fees and other incentives function, may want to skip ahead to Section D (Government Issues) and Section E (Contractor Questions).

B. How Incentives Function

- Selection of contract type is the basis of a system of “incentives and penalties” to guide the contractor in its performance.
- Government contracts may be firm-fixed-price or cost-reimbursable.
- In firm-fixed-price contracts, the contractor takes sole responsibility for the project coming in over or under budget, paying for all costs over budget (cost overruns) and receiving additional profit if the project comes in under budget.

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Given the frequent cost overruns of software development projects, the government should strongly prefer this type of contract.

- In cost-reimbursable contracts, the government reimburses the contractor for all project costs.
- Both types of contracts may include contract incentives related to program parameters, specifically project cost, schedule, or performance.
- Award fee contracts are a type of incentive contract.
- All incentive contracts must include cost incentives (FAR, Subpart 16.402). Incentive contracts include the following:
 1. Negotiated target cost
 2. Cost incentive
 3. Target profit or fee
 4. Profit or fee adjustment formula, working within either a price ceiling or a minimum or maximum fee
 5. Other optional incentives, especially schedule and project performance incentives
 6. A negotiated process by which the government evaluates how well the contractor meets incentive targets
- Contract incentives for cost, schedule, and performance function as follows:
 1. The contracting organization receives the target incentive (structured either as additional profit or as a fee) when it meets the negotiated target program parameter in cost, schedule, and/or performance

2. The government bases any adjustment (up or down) of the target incentive or fee on a specific formula analyzing project cost, schedule, and/or performance
3. If project cost exceeds negotiated target cost (i.e. the project suffers cost overruns), the government reduces contractor payments by either the amount of the overrun or an agreed-upon percentage of the overrun. This shares fairly the burden of overruns between the government and contractor
4. Again, the government and the contractor negotiate the percentage of cost overruns shared by the contractor
5. If project cost is lower than target cost, the government rewards the contractor either with the difference or with an agreed-upon percentage of the difference.

C. How Award Fees Function

- An award fee (whether the contract is fixed-price or cost-reimbursable) consists of (a) a base amount (which may be zero) fixed at inception of the contract and (b) an award amount, based upon a judgmental evaluation by the government, sufficient to provide motivation for excellence in contract performance.
- The government may establish award fee incentives meeting the following criteria (FAR, Subpart 16.404):

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1. The government pays any award fee in addition to an established fixed price for the contract
 2. The established fixed price includes normal profit
 3. The Award Fee Plan (AFP*), outlined in a contract attachment, grades contractor performance in negotiated areas
 4. The government performs periodic evaluations of contractor performance against the AFP
 5. The contractor chooses whether to use the contract's award fee provision
 6. The AFP identifies the following:
 - a) The Fee-Determining Official
 - b) The composition of the government's Award Fee Review Board (AFRB)
 - c) Award fee criteria
 - d) Award fee evaluation periods
 - e) Potential award fees per period
 - f) General procedures for determining the award fee in each period
 7. The government generally uses award fee incentives only when it cannot define contract requirements in sufficient detail to allow performance-based contracting
 8. The government may set up award fees in any type of contract, at any stage of the software project life cycle.
- According to FAR, subpart 16.4, the government may institute award fee contracts whenever it meets two conditions:
 - a) it deems a firm-fixed-price contract inappropriate; and b) it believes the award fee contract will help acquire the needed product at a lower overall cost.In the context of software development projects, award fees make sense for the following reasons:
 1. The widespread failure by software development contractors to use best practices, and the impressive benefits to the government of using best practices, make the use of award fees or other incentives to encourage best practices eminently sensible
 2. The frequent cost overruns on government software development projects make it unlikely that contractors will agree to firm-fixed-price contracts
 3. Independent analyses by the Software Program Managers Network (SPMN) and other organizations of the cost overruns endemic to software projects have concluded that the use of best practices that lower cost and increase cost predictability would prevent cost overruns. Thus, using the tool of award fees to encourage the use of best practices would likely lower overall project cost
 4. The government thus meets both FAR requirements [conditions a) and b) above] for award fee usage for software development projects.

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- The government determines unilaterally whether and how much of the award fee to pay the contractor. This government decision is not subject to the Disputes Clause. FAR expressly excludes the operation of the Disputes Clause in any disagreement by the contractor concerning the amount of the award fee.
- The government may use award fee provisions in fixed-price contracts when other incentives cannot be used because contractor performance cannot be measured objectively.
- If the government uses a fixed-price contract, the fixed price includes normal profit. The government will pay this price for satisfactory program parameters, and pay any award fee earned in addition to that fixed price.
- The government may use cost-plus-award-fee contracts when the work to be performed is such that it is neither feasible nor effective to devise predetermined objective incentive targets applicable to cost, technical performance, or schedule.
- A cost-plus-award-fee contract is a cost-reimbursement contract that provides for a fee consisting of a) a base amount fixed at inception of the contract and b) an award amount that the contractor may earn in whole or in part during performance.
- Award fee contracts shall provide for evaluation at stated intervals during performance, so that the contractor will periodically be informed of the quality of its performance and the areas in which improvement is expected. Partial payment of fee shall generally correspond to

the evaluation periods. This makes effective the incentive which the award fee can create, by inducing the contractor to improve poor performance or to continue good performance.

D. Government Issues

- Goals: Incentives demand careful consideration by the government. The government must clearly understand the goals of each incentive it establishes for a given project. What does the government really need (in terms of project cost, schedule, and/or performance)? Is the government asking for anything in its requirements or other project characteristics that is wanted but not needed? Is there “value added” without being “value-needed?”
- Benefits: Award fees and other incentives do not manage themselves. The benefits of establishing incentives must outweigh the administrative costs the government will incur in managing the award fee or other incentive contract.
- Rationale: The increased chances of the government receiving a quality software product may justify the labor-intensive nature of the process. Furthermore, given the difficulties of software development generally, and in particular the difficulties of the large-scale software development projects common in government and military software projects, the government should strongly consider utilizing any additional tool likely to generate concrete improvements in project parameters.
- Priorities and Tradeoffs: Which of the following criteria does the government

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Award fees and other Incentives

prioritize—project performance, schedule, cost, or other factors? What is important? How and why is it important? [If cost, schedule, and performance are dominant and readily measured, maybe award fee is inappropriate.] However, again, the government needs to think “outside of the box.” The number of evaluation criteria and the requirements they represent will differ widely among contracts. The criteria and rating plan should motivate the contractor to improve performance in the areas rated, but not at the expense of at least minimum acceptable performance in all other areas.

- Bottom-Line Program Parameters: How can the government link award fee or other incentives criteria (e.g., by using the AFP) with software project success parameters such as end user satisfaction, development cost, development productivity, maintenance cost, maintenance productivity, software quality, time-to-market, and cost and schedule predictability?
- Best Practices Linking: How can the government link award fee or other incentives criteria (e.g., by using the AFP) with best practices such as risk management, earned value requirements management, interface management, planning and tracking, quality gates, peer reviews, program-wide visibility of progress vs. plan, configuration management, and people-aware management?
- Flexibility: Does the AFP provide the government with the flexibility to evaluate both actual performance and the conditions under which it was achieved?
- Responsibility of Government/Contractor: How does the government plan to apply particular incentives in cases where its own action or inaction, or other factors beyond the control of the contractor, affect the project negatively or otherwise impact on contractor achievement of incentives criteria? For instance, for delivery incentives, how does the government plan to apply these incentives in the event of government-caused delays or other delays beyond the control of, or not due to the fault or negligence of, the contractor? Also, frequent requirements change on software projects, related to poor requirements management by the contractor and/or government, may function as contractual changes impacting on performance and other incentives.
- Risk Management: Can the government encourage the contractor to implement a more rigorous risk management process by requiring that the contractor outline precisely those risks where external dependencies (e.g., on the government, subcontractors, etc.) could adversely affect program parameters or incentives criteria?
- Objective Evaluation Process: How can the government ensure, whenever possible, that its evaluation process measures incentives objectively rather than subjectively? The incentive review process often risks subjective evaluations not truly measuring bottom-line program parameters.
- Testing and Performance Incentives: The contractor's testing program may need government evaluation to determine its usefulness in supporting perfor-

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mance incentive decisions (see also Chapter 4, Quality, of this guidebook).

- Components and Performance Incentives: How can the government separate out, for the purpose of performance incentives, the impact on project performance of government components vs. the impact of contractor components?
 - History: Multiple-incentive contracts were popularly used and misused throughout the 1960s and 1970s.
 - Steps: Can the government achieve its goals in one fell swoop, or is it more realistic to use an iterative approach and series of goals?
 - Metrics: Knowing what is needed and what, how, and why it is important, how can achievement be measured so that the contractor may be reimbursed for that achievement, and receive additional award for achievement beyond that “reasonably” expected? Whatever factor award is to be based upon, is there an accounting system adequate for determining that factor?
 - Evaluation: What constitutes appropriate government evaluation and monitoring during performance, and is it in place?
 - Type of Contract: Since it is usually to the government's advantage for the contractor to assume substantial cost responsibility and an appropriate share of the cost risk, the government should prefer fixed-price, award fee contracts when contract costs and performance requirements are reasonably certain.
- AFP Procedures:
 1. What procedures need to be established for conducting the award fee evaluation?
 2. For this particular project, at what points in the project schedule would government evaluation of contractor performance against the AFP be most appropriate? How do these schedule points correspond with the best practices of a) binary quality gates at the “inch-pebble” (as opposed to “milestone”) level, and b) earned value management?
 3. Which government individual, senior to the government contracting officer, approved the award fee plan?
 4. Is it clearly understood that the amount of the award fee to be paid is determined by the government's judgmental evaluation of the contractor's performance in terms of the criteria stated in the contract, and is not subject to the Disputes Clause?
 - Award Fee Review Board:
 1. Has an Award Fee Review Board been established by the government and agreed to by contractor?
 2. What characteristics, background, experience, or skills should the members of the Award Fee Review Board possess?
 - Motivation: What size award fee is sufficient to provide motivation for the contractor to implement proven best practices and improve bottom-line program parameters? Do contractors agree with

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the government that this amount is sufficient?

- In what “box” do you currently think? What limits might that “box” impose on your ability to receive a successful software project from a contractor?

E. Contractor Questions

- Goals: What can you really provide? Are you providing anything that is not needed? Is all “value” truly “needed?”
- How will your risk management system interact with the contract incentive system to help you meet the negotiated targets for this program? In other words, how will you ensure that unforeseen risks do not become problems preventing your attaining program targets for cost, schedule, and performance?
- How will you decide whether or not delays or other program problems are due to events beyond your control or not otherwise your responsibility? How will you work or communicate with the government or your subcontractors to allocate or define responsibility? Given the essential nature of a strong risk management program for software project success, what portion of responsibility will you own for program problems? What award fee or other incentive reductions would appropriately correspond to your responsibility?
- Do you use a common database with standardized outputs for all program schedules? Do your database outputs contain various levels of detail and sorts for different program management levels/functions? Do your program schedules trace horizontally and vertically no matter the sort?
- Have you established measurement baselines for program parameters, including project cost, schedule, and performance? If so, please describe your measurement baselines. How do you measure program achievements such that the government may reimburse you for “reasonable achievement” and give additional award for achievement beyond that “reasonably” expected?
- Have you implemented a measurement system in which you and the government may assess program progress versus your measurement baselines? If so, please describe your system. How often do you monitor this system to determine whether the program is meeting its targets?
- How would you propose that the government tailor this contract to the needs of this particular software project?
- Do you understand that the government determines unilaterally whether and how much of the award fee to pay you, and that this government decision is not subject to the Disputes Clause?
- Whatever factor award is to be based upon, is there an accounting system adequate for determining that factor?



CHAPTER 6

Other Major Issues

CHAPTER 6

Other Major Issues

A. Architecture

- Describe commonalities and differences between your framework for a component-based architecture and each of ActiveX, DCOM, JavaBeans and CORBA. Consider why these specific commonalities and differences were chosen to support each of the following:
 1. DII COE compliance
 2. JTA compliance
 3. Integration of COTS software products
 4. Reuse of existing Government-Off-the-Shelf (GOTS) software modules
 5. System update/upgrade with release of new component versions, instead of system versions
 6. Compatibility with required external interfaces
 7. Future portability to new computer hardware and operating systems
 8. Minimizing future excessive costs of replacing COTS components from one vendor with COTS components of similar capability from a different vendor.
- Identify and characterize the most severe risk items for the development of the component-based architecture framework. A risk item is characterized by its probability of materializing and by the negative impact made if it does materialize. For each identified risk item, describe your workaround if the risk materializes.
- Will components developed in compliance with API specifications for the component-based framework be capable of being plugged into an architecture framework that is compliant with one or more of ActiveX, DCOM, JavaBeans, and CORBA? For each case where the answer is yes, give a technical description of how the component can be plugged in.
- Describe your approach to developing a component-based architecture framework that will ensure a third party can develop components that will plug into applications implemented from the framework, with no information other than framework API specifications.
- Describe in technical detail what you will do, under contract, to verify that the deliverable, component-based architecture framework will:
 1. Allow any component, whose API complies with framework specifications, to be plugged into the architecture, enabling it to extend the capabilities of the application or to replace an earlier version of the component
 2. Support current and potential future system security requirements
 3. Support current and potential future system performance requirements
 4. Support current and potential future system safety requirements
 5. Support current and potential future requirements for interfaces with external systems.

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- Describe any technical requirements that will be imposed on external systems to enable them to interface with a component in the component-based architecture framework.

B. Software Integrated Product Teams

- Identify the individual Integrated Product Teams (IPTs) that you recommend, the membership of each, the management reporting chain, and the responsibility and authority for each.
- Discuss the division of responsibility and authority between IPTs and individuals in the management and technical organizations of this project.
- What percentage of the total person-hours during development will be spent participating in IPTs?

C. Software Documentation

- On large projects, software documentation can represent a substantial cost component. Describe the techniques that you will use to deliver adequate documentation at reduced cost.
- How will you document the system, network, and CSCI architectures? When will this documentation be put under internal configuration change control?
- How will you document the requirements and the design of internal interfaces?
- Will you generate software development files and, if so, what information will be contained in these files? Will software

development files be delivered to the customer?

- How will you document requirements traceability?
- What configuration management documentation will you deliver to the customer?
- What documentation will you generate related to test, and what part of this documentation will be delivered to the customer?

D. Project-Unique Issues

- Discuss any constraints or unusual requirements that the customer project office, future system users, or government policy has imposed that increase cost, schedule or risk.
- Discuss any technical issues or methods that are substantially different from previous experiences of your organization.
- Discuss all factors in this program that could have a significant impact on productivity, schedule, quality, user satisfaction, and cost and schedule predictability that do not have a similar negative impact on most projects of this type and size.

E. People Incentives

- One risk with large software projects is that valuable workers may leave before the project is completed. What is your threshold between low and moderate risk in the monthly rate that persons on your team will leave the project before their work is completed? What is the basis for

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this threshold? Describe your approach to keeping your voluntary staff turnover rate below this threshold.

- Will any portion of the award fees earned on this contact be distributed among the best performers on the management and development teams of the contractor and its subcontractors? If so, discuss the portion that will be shared and the method of determining how this portion will be allocated among the staff.
- One reason why workers leave a project early is uncompensated overtime. Do you have a threshold between low and moderate risk for uncompensated overtime that causes persons to seek employment with another organization?
- Discuss specific practices that you will follow on this project which encourage individuals on your technical staff not to quit the project before you have planned their departure.

APPENDIX

Airlie Contracting Panel
Background and Highlights

APPENDIX

Airlie Contracting Panel Background and Highlights

Since 1994, the Airlie Software Council of the Software Program Managers Network (SPMN) has held regular meetings at the Airlie Conference Center outside Warrenton, VA, to discuss major issues and problems concerning the management of large-scale software projects. These meetings have resulted in groundbreaking practices and products geared toward improving U.S. software competitiveness.

In October, 1996, the Software Program Managers Network broke more new ground by gathering a different meeting of the minds at Airlie. Aware that government program managers and contractors face major problems, conflicts, and issues, SPMN formed the Airlie Contracting Panel to identify some practical solutions.

The Panel, described previously in the Introduction, analyzed the following obstacles that adversely affect program managers in the successful performance of their contracting duties.

- No cost containment. The Panel generally agreed that government program managers are constantly troubled by the lack of incentives to entice contractors to reduce project cost. Current contracting practices actually reward contractors for cost overruns via a system that provides higher revenue and profits to contractors who take longer to complete a project. Without reduction incentives, costs inevitably rise. As a result, the government or customer is not only liable for all project risks but must also pay for increased costs. While implementing software industry best practices can and does reduce costs, the customer must
- first create incentives to persuade contractors to use these known best practices.
- Unbalanced project control. The current contracting system also greatly frustrates program managers because, while program managers must still assume all risks and costs, they have rather limited control at best over their projects. Direct project control is in the hands of the contractor. In the private sector, such a situation surely would lead to financial disaster. Yet in the government, a combination of hands-off management, software confusion, poor productivity, program defects, and system failures can, as a result, cost taxpayers billions, cost a soldier his or her life, and cost our nation her economic or military security. In addition, program managers must also establish a method to restrain Commercial-Off-the-Shelf (COTS) software costs in the government.
- Human resources shortage and people management. Program managers should be aware of the importance of human resources issues, specifically with regard to the shortage of good software people in the United States. Program managers need to understand that some programs fail because of the lack of trained software personnel. As a result, program managers should avoid personnel disruption and retain valuable employees. In the government, there is currently a scarcity of staff who really know software.
- Failure to learn from past performance. Program management must more fully

APPENDIX

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grasp and use a contractor's past performance in order to predict present and future contractor successes and failures.

- Increased project size and complexity. An increase in software size and complexity often leads to software chaos, user confusion, cost overruns, poor functionality, deliverables not fulfilling project functionality, and other headaches for program managers.
- Poor planning. Program managers need to utilize better planning and tracking methods, along with an improved understanding of all aspects of the build process.
- Expensive rework. On large, software-intensive projects, rework typically accounts for 35 percent to 45 percent of development costs. The cost of finding and fixing errors grows rapidly with the time spent between making the error and finding the error. By managing change better, program management can minimize expensive rework.

PANEL GOALS

To address the above problems, the Panel decided on four major objectives:

1. Create a sample document of software acquisition questions the government can ask contractors
2. Identify what the companion products to this document are, and how these products can be evaluated
3. Determine how to create an award/fee structure that encourages contractors to produce what the government or customer needs

4. Improve record keeping and review contractors' present project performance in order to evaluate their future proposals more effectively.

PANEL DISCUSSION

The Panel also discussed creating a contract incentives model and outlined some basic considerations for the model, including whether incentives or penalties should serve as the prime motivation. Addressing risk management, it was also suggested that the government adapt best commercial practices from national prototype tools and templates into meaningful questions to ask contractors. There was a recommendation for adherence to past performance penalties and making them a factor that affects contractor bottom line. This model emphasizes equitable risk sharing between government and contractor.

It was advocated that the government should advance rework reduction. Since rework increases contractor profits, unless contractual incentives are established, no impetus exists to reduce rework. Software development strategies that reduce rework include:

- Early problem identification
- Implementing a planning and tracking process in software building
- Change and complexity management
- Crisis avoidance
- More effective management of personnel resources.

One Panel member pointed out that all Acquisition Category (ACAT) I/II/III programs engage in cost-reduction programs. Both the program manager and the contrac-

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tor need empowerment and must address project affordability.

Overall, the Panel concurred that only by applying past examples and successes could program managers achieve bottom-line productivity, timeliness, quality, and customer satisfaction. The group also agreed that the Panel should:

- Help the government to discover and explore those contractor qualities that produce successful projects
- Provide the government with some basic start-up tools in the form of samples and documents for program managers.
- Remember to weigh contractors' answers alongside their performance history.
- It can be dangerous to lock contractors into too exact a method of performance. Rather than placing the contractor in a bind if a problem arises, the government should be more interested in receiving a good product on time.
- The government MUST be convinced that the contractor has a workable risk management process. Consequently, a sophisticated metric is needed to determine if the risk management process is on track.

PANEL CONCERNS

Panel members, however, voiced the following cautions and comments regarding the first draft of this guidebook:

- If template questions are too detailed, contractors may feel as though they are being led by the nose.
- The template's objective is not to make grading the contractor easy, only better. Although it may be difficult to accomplish this, it will be well worth the effort.
- Detailed questions can be positive, forcing the contractor to define architecture up front, or negative, because there is no way to determine who writes proposals, so an inferior company can employ a super proposal writer, or vice versa. In other words, a hired top gun can make a mediocre company look spectacular. It is therefore important to focus on the actual program and its needs and not just a contractor's answers to these questions.

GLOSSARY

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GLOSSARY

Glossary

ACAT—Acquisition Category.

API—Automated Program Interface.

Architecture—The structure and interrelation of a system's components, including the relation of the interface to its operational environment.

Best Practices—The software industry management and technical practices consistently shown by metrics or measures in real-world software development and maintenance programs to improve consistently bottom-line program parameters (including end user satisfaction, development cost, development productivity, maintenance cost, maintenance productivity, software quality, time-to-market, and cost and schedule predictability).

CASE (Computer-Aided Software Engineering)—The industrialization of software engineering techniques and computer technology to improve and automate the practice of information systems development.

Component—The collection of programs and modules that perform a single identified technical or business function. Examples of components include the scheduler of an operating system or the parser of a compiler.

Configuration management—The process of identifying and defining the deliverable product set in a system, controlling the release and change of these items throughout the system life cycle, recording and reporting the status of product items and change requests, and verifying the completeness and correctness of the product items.

COTS—Commercial-Off-the-Shelf (often used in reference to software).

CSCI—Computer Software Configuration Item.

Defect—A problem or “bug” that, if not removed, could cause a program to either produce erroneous results or fail.

Deliverable—A tangible, physical object that is the output of a software development task. Some examples of deliverables include requirements documents, specifications, test cases, and source code.

Design—The tasks associated with specifying and sketching out the features and functions of a new application prior to formal coding.

Earned value—A means of evaluating budgetary performance by relating actual expenditures to technical achievement as measured by a milestone accomplishment scheme.

Effort—The person-months or person-years of work by all job classifications on the software product (e.g., design, coding, inspection, testing, documentation, and supervision).

GOTS—Government-Off-the-Shelf (often used in reference to software).

Inspection—A visual examination to detect errors and standards violations in requirements, design, code, user documentation, test plans and cases, and other software development products.

HWCI—Hardware Configuration Item.

Interface—The boundary between two programs, two pieces of hardware, or a computer and its user.

IPT (Integrated Product Team)—Multidisciplinary group organized around products and accountable for the development and delivery of one or more products.

Leaf task—A task with no child tasks.

GLOSSARY

Glossary

Metrics—Means by which software engineers measure and predict aspects of processes, resources, and products that are relevant to the software engineering activity.

NDI—Nondevelopmental Item.

Peer review—A type of review that peers conduct to evaluate a product, such as a segment of design or unit of code. Peer reviews may be formal or informal. Walkthroughs and inspections are often conducted as peer reviews.

Risk—The probability that a software project will experience potential hazards that will affect the schedule or completion of the project.

Run-time library—The complete set of software that must be in primary storage while a user program is being executed.

Quality—The totality of features and characteristics of a product that bears on its ability to satisfy given needs.

Quality assurance—All the planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

Reuse—The ability to make additional use of standard parts or components such as reusable code, design, architectures, and test cases.

SQA (Software Quality Assurance)—A program that minimizes the number of defects in delivered software, creates mechanisms for controlling software development and maintenance to guard against schedule and cost overruns, ensures product usability, and improves future product/release quality.

Voluntary staff turnover—A measurement of employees the project wants to keep, but who have chosen to leave.

WBS (Work Breakdown Structure)—The product- or activity-oriented hierarchy tree depicting the elements of work that need to be accomplished in order to deliver an end product to the customer.

REFERENCES

- 1 The Software Program Managers Network (SPMN) is a Tri-Services organization dedicated to improving the management of software acquisition, development, and maintenance.
- 2 Software Program Managers Network, *Software Acquisition Best Practices Initiative*, Version 2.0, 1997.



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CHAPTER 5

Award fees and other
Incentives

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Award fees and other Incentives

A. Chapter Summary

- Award fees and other incentives can motivate contractors to use software development best practices. By encouraging the use of best practices, innovative incentives can improve bottom line program parameters (including end user satisfaction, development cost, development productivity, maintenance cost, maintenance productivity, software quality, time-to-market, and cost and schedule predictability).
- This chapter first defines how award fees and other incentives function, then raises issues regarding award fees and other incentives for the government to consider before it forms contractor questions, and, finally, suggests possible contractor questions related to incentives.
- Selecting the type of contract to be implemented is as fundamental a decision as there is in the acquisition process. In the software acquisition process, the complex nature of the effort and the end-product may require an extra level of sophistication or experience on the part of the government as well as the contractor.
- The government team and the contractor team have in-depth acquisition decisions to make of both a business and engineering nature.
- In more recent years, the “award fee” contract has been found effective when used for software projects. The most successful software projects have been government and contractor teams which work closely together and think “outside of the box.”
- Government thinking on incentives must go beyond fulfilling the many specific Federal Acquisition Regulations (FAR). The government and contractor teams individually and together must be inventive and innovative.
- After the individual government and contractor teams look at the same contract from different sides, it is imperative that they look at that contract from all sides together.
- This chapter refers frequently to the Federal Acquisition Regulations governing contracts and contract incentives. Readers interested in studying the FAR, an essential step for adequate contract preparation, can download it at the following Web site:
www.arinet.gov/far/97-01/html.
- More experienced government acquisition specialists, who already know very well how award fees and other incentives function, may want to skip ahead to Section D (Government Issues) and Section E (Contractor Questions).

B. How Incentives Function

- Selection of contract type is the basis of a system of “incentives and penalties” to guide the contractor in its performance.
- Government contracts may be firm-fixed-price or cost-reimbursable.
- In firm-fixed-price contracts, the contractor takes sole responsibility for the project coming in over or under budget, paying for all costs over budget (cost overruns) and receiving additional profit if the project comes in under budget.

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Given the frequent cost overruns of software development projects, the government should strongly prefer this type of contract.

- In cost-reimbursable contracts, the government reimburses the contractor for all project costs.
- Both types of contracts may include contract incentives related to program parameters, specifically project cost, schedule, or performance.
- Award fee contracts are a type of incentive contract.
- All incentive contracts must include cost incentives (FAR, Subpart 16.402). Incentive contracts include the following:
 1. Negotiated target cost
 2. Cost incentive
 3. Target profit or fee
 4. Profit or fee adjustment formula, working within either a price ceiling or a minimum or maximum fee
 5. Other optional incentives, especially schedule and project performance incentives
 6. A negotiated process by which the government evaluates how well the contractor meets incentive targets
- Contract incentives for cost, schedule, and performance function as follows:
 1. The contracting organization receives the target incentive (structured either as additional profit or as a fee) when it meets the negotiated target program parameter in cost, schedule, and/or performance
 2. The government bases any adjustment (up or down) of the target incentive or fee on a specific formula analyzing project cost, schedule, and/or performance
 3. If project cost exceeds negotiated target cost (i.e. the project suffers cost overruns), the government reduces contractor payments by either the amount of the overrun or an agreed-upon percentage of the overrun. This shares fairly the burden of overruns between the government and contractor
 4. Again, the government and the contractor negotiate the percentage of cost overruns shared by the contractor
 5. If project cost is lower than target cost, the government rewards the contractor either with the difference or with an agreed-upon percentage of the difference.

C. How Award Fees Function

- An award fee (whether the contract is fixed-price or cost-reimbursable) consists of (a) a base amount (which may be zero) fixed at inception of the contract and (b) an award amount, based upon a judgmental evaluation by the government, sufficient to provide motivation for excellence in contract performance.
- The government may establish award fee incentives meeting the following criteria (FAR, Subpart 16.404):

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1. The government pays any award fee in addition to an established fixed price for the contract
 2. The established fixed price includes normal profit
 3. The Award Fee Plan (AFP*), outlined in a contract attachment, grades contractor performance in negotiated areas
 4. The government performs periodic evaluations of contractor performance against the AFP
 5. The contractor chooses whether to use the contract's award fee provision
 6. The AFP identifies the following:
 - a) The Fee-Determining Official
 - b) The composition of the government's Award Fee Review Board (AFRB)
 - c) Award fee criteria
 - d) Award fee evaluation periods
 - e) Potential award fees per period
 - f) General procedures for determining the award fee in each period
 7. The government generally uses award fee incentives only when it cannot define contract requirements in sufficient detail to allow performance-based contracting
 8. The government may set up award fees in any type of contract, at any stage of the software project life cycle.
- According to FAR, subpart 16.4, the government may institute award fee contracts whenever it meets two conditions:
 - a) it deems a firm-fixed-price contract inappropriate; and b) it believes the award fee contract will help acquire the needed product at a lower overall cost. In the context of software development projects, award fees make sense for the following reasons:
 1. The widespread failure by software development contractors to use best practices, and the impressive benefits to the government of using best practices, make the use of award fees or other incentives to encourage best practices eminently sensible
 2. The frequent cost overruns on government software development projects make it unlikely that contractors will agree to firm-fixed-price contracts
 3. Independent analyses by the Software Program Managers Network (SPMN) and other organizations of the cost overruns endemic to software projects have concluded that the use of best practices that lower cost and increase cost predictability would prevent cost overruns. Thus, using the tool of award fees to encourage the use of best practices would likely lower overall project cost
 4. The government thus meets both FAR requirements [conditions a) and b) above] for award fee usage for software development projects.

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- The government determines unilaterally whether and how much of the award fee to pay the contractor. This government decision is not subject to the Disputes Clause. FAR expressly excludes the operation of the Disputes Clause in any disagreement by the contractor concerning the amount of the award fee.
- The government may use award fee provisions in fixed-price contracts when other incentives cannot be used because contractor performance cannot be measured objectively.
- If the government uses a fixed-price contract, the fixed price includes normal profit. The government will pay this price for satisfactory program parameters, and pay any award fee earned in addition to that fixed price.
- The government may use cost-plus-award-fee contracts when the work to be performed is such that it is neither feasible nor effective to devise predetermined objective incentive targets applicable to cost, technical performance, or schedule.
- A cost-plus-award-fee contract is a cost-reimbursement contract that provides for a fee consisting of a) a base amount fixed at inception of the contract and b) an award amount that the contractor may earn in whole or in part during performance.
- Award fee contracts shall provide for evaluation at stated intervals during performance, so that the contractor will periodically be informed of the quality of its performance and the areas in which improvement is expected. Partial payment of fee shall generally correspond to

the evaluation periods. This makes effective the incentive which the award fee can create, by inducing the contractor to improve poor performance or to continue good performance.

D. Government Issues

- Goals: Incentives demand careful consideration by the government. The government must clearly understand the goals of each incentive it establishes for a given project. What does the government really need (in terms of project cost, schedule, and/or performance)? Is the government asking for anything in its requirements or other project characteristics that is wanted but not needed? Is there “value added” without being “value-needed?”
- Benefits: Award fees and other incentives do not manage themselves. The benefits of establishing incentives must outweigh the administrative costs the government will incur in managing the award fee or other incentive contract.
- Rationale: The increased chances of the government receiving a quality software product may justify the labor-intensive nature of the process. Furthermore, given the difficulties of software development generally, and in particular the difficulties of the large-scale software development projects common in government and military software projects, the government should strongly consider utilizing any additional tool likely to generate concrete improvements in project parameters.
- Priorities and Tradeoffs: Which of the following criteria does the government

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prioritize—project performance, schedule, cost, or other factors? What is important? How and why is it important? [If cost, schedule, and performance are dominant and readily measured, maybe award fee is inappropriate.] However, again, the government needs to think “outside of the box.” The number of evaluation criteria and the requirements they represent will differ widely among contracts. The criteria and rating plan should motivate the contractor to improve performance in the areas rated, but not at the expense of at least minimum acceptable performance in all other areas.

- Bottom-Line Program Parameters: How can the government link award fee or other incentives criteria (e.g., by using the AFP) with software project success parameters such as end user satisfaction, development cost, development productivity, maintenance cost, maintenance productivity, software quality, time-to-market, and cost and schedule predictability?
- Best Practices Linking: How can the government link award fee or other incentives criteria (e.g., by using the AFP) with best practices such as risk management, earned value requirements management, interface management, planning and tracking, quality gates, peer reviews, program-wide visibility of progress vs. plan, configuration management, and people-aware management?
- Flexibility: Does the AFP provide the government with the flexibility to evaluate both actual performance and the conditions under which it was achieved?
- Responsibility of Government/Contractor: How does the government plan to apply particular incentives in cases where its own action or inaction, or other factors beyond the control of the contractor, affect the project negatively or otherwise impact on contractor achievement of incentives criteria? For instance, for delivery incentives, how does the government plan to apply these incentives in the event of government-caused delays or other delays beyond the control of, or not due to the fault or negligence of, the contractor? Also, frequent requirements change on software projects, related to poor requirements management by the contractor and/or government, may function as contractual changes impacting on performance and other incentives.
- Risk Management: Can the government encourage the contractor to implement a more rigorous risk management process by requiring that the contractor outline precisely those risks where external dependencies (e.g., on the government, subcontractors, etc.) could adversely affect program parameters or incentives criteria?
- Objective Evaluation Process: How can the government ensure, whenever possible, that its evaluation process measures incentives objectively rather than subjectively? The incentive review process often risks subjective evaluations not truly measuring bottom-line program parameters.
- Testing and Performance Incentives: The contractor's testing program may need government evaluation to determine its usefulness in supporting perfor-

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mance incentive decisions (see also Chapter 4, Quality, of this guidebook).

- **Components and Performance Incentives:** How can the government separate out, for the purpose of performance incentives, the impact on project performance of government components vs. the impact of contractor components?
- **History:** Multiple-incentive contracts were popularly used and misused throughout the 1960s and 1970s.
- **Steps:** Can the government achieve its goals in one fell swoop, or is it more realistic to use an iterative approach and series of goals?
- **Metrics:** Knowing what is needed and what, how, and why it is important, how can achievement be measured so that the contractor may be reimbursed for that achievement, and receive additional award for achievement beyond that “reasonably” expected? Whatever factor award is to be based upon, is there an accounting system adequate for determining that factor?
- **Evaluation:** What constitutes appropriate government evaluation and monitoring during performance, and is it in place?
- **Type of Contract:** Since it is usually to the government's advantage for the contractor to assume substantial cost responsibility and an appropriate share of the cost risk, the government should prefer fixed-price, award fee contracts when contract costs and performance requirements are reasonably certain.

- **AFP Procedures:**

1. What procedures need to be established for conducting the award fee evaluation?
2. For this particular project, at what points in the project schedule would government evaluation of contractor performance against the AFP be most appropriate? How do these schedule points correspond with the best practices of a) binary quality gates at the “inch-pebble” (as opposed to “milestone”) level, and b) earned value management?
3. Which government individual, senior to the government contracting officer, approved the award fee plan?
4. Is it clearly understood that the amount of the award fee to be paid is determined by the government's judgmental evaluation of the contractor's performance in terms of the criteria stated in the contract, and is not subject to the Disputes Clause?

- **Award Fee Review Board:**

1. Has an Award Fee Review Board been established by the government and agreed to by contractor?
2. What characteristics, background, experience, or skills should the members of the Award Fee Review Board possess?

- **Motivation:** What size award fee is sufficient to provide motivation for the contractor to implement proven best practices and improve bottom-line program parameters? Do contractors agree with

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the government that this amount is sufficient?

- In what “box” do you currently think? What limits might that “box” impose on your ability to receive a successful software project from a contractor?

E. Contractor Questions

- Goals: What can you really provide? Are you providing anything that is not needed? Is all “value” truly “needed?”
- How will your risk management system interact with the contract incentive system to help you meet the negotiated targets for this program? In other words, how will you ensure that unforeseen risks do not become problems preventing your attaining program targets for cost, schedule, and performance?
- How will you decide whether or not delays or other program problems are due to events beyond your control or not otherwise your responsibility? How will you work or communicate with the government or your subcontractors to allocate or define responsibility? Given the essential nature of a strong risk management program for software project success, what portion of responsibility will you own for program problems? What award fee or other incentive reductions would appropriately correspond to your responsibility?
- Do you use a common database with standardized outputs for all program schedules? Do your database outputs contain various levels of detail and sorts for different program management levels/functions? Do your program schedules trace horizontally and vertically no matter the sort?
- Have you established measurement baselines for program parameters, including project cost, schedule, and performance? If so, please describe your measurement baselines. How do you measure program achievements such that the government may reimburse you for “reasonable achievement” and give additional award for achievement beyond that “reasonably” expected?
- Have you implemented a measurement system in which you and the government may assess program progress versus your measurement baselines? If so, please describe your system. How often do you monitor this system to determine whether the program is meeting its targets?
- How would you propose that the government tailor this contract to the needs of this particular software project?
- Do you understand that the government determines unilaterally whether and how much of the award fee to pay you, and that this government decision is not subject to the Disputes Clause?
- Whatever factor award is to be based upon, is there an accounting system adequate for determining that factor?